DTE Consumers Energy Count on Us®

Guidehouse
Outwit Complexity

Smart Thermostat Calibration Study

Presentation to the EWR Collaborative

October 2023

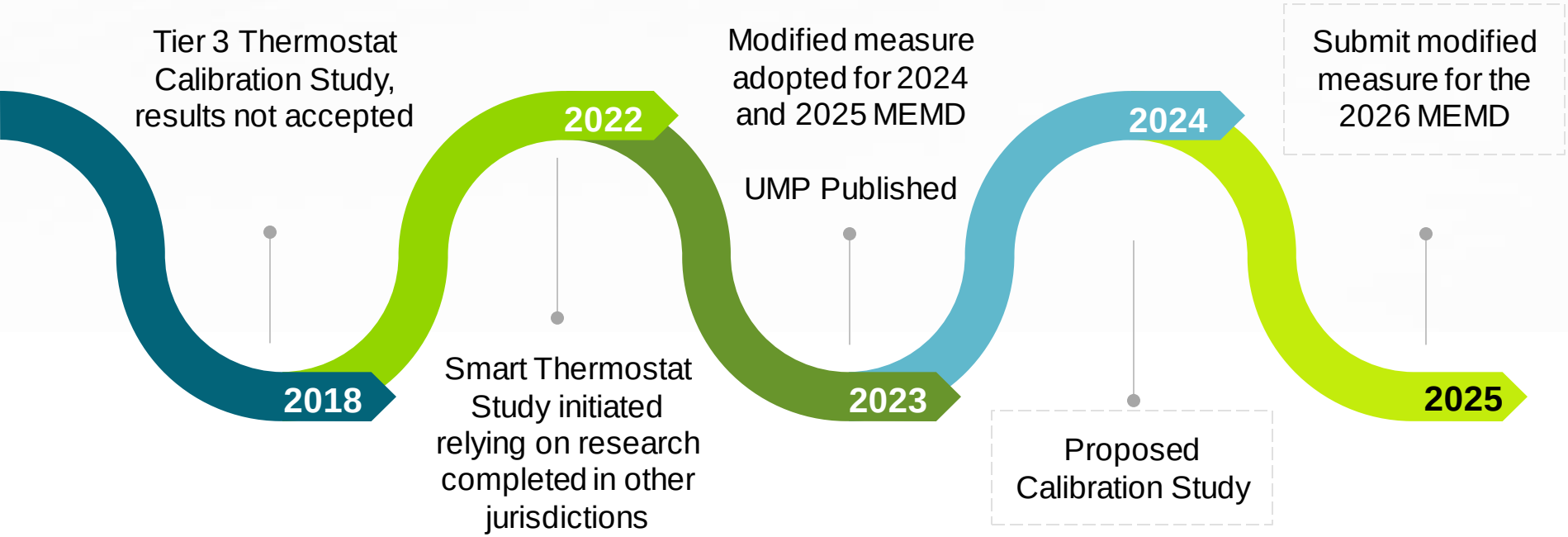
Agenda

01 **Background**

02 **Approach**

03 **Schedule**

Background



We propose a whole-home consumption data analysis approach for calibration.

This proposed approach will rely on Michigan-specific primary data and adheres to the recommendations in the *Smart Thermostat Evaluation Protocol (DOE/NREL UMP)* published in 2023.

Develop and implement a **stakeholder engagement** process to solicit feedback on study design and methods and at key milestones throughout the study (methodology, matching + survey results, analysis results)

Use regression analysis to **estimate energy savings** resulting from customer participation in utility smart thermostat programs

Conduct **surveys** to assess whether additional energy-related changes occurred during the year prior to or following thermostat installation and adjust savings estimates accordingly

Develop and submit a **modified measure workpaper** for inclusion in the 2026 MEMD

Guidehouse
Outwit Complexity

Study Design to Estimate Savings

Analysis	May - Sep 21	Oct 21 – Apr 22	May – Sep 22	Oct 22 – Apr 23	May – Sep 23	Oct 23 – Apr 24
Cooling Season Analysis	Pre-Program Matching Period	Installation Period	Study Period	Future Participants		
Heating Season Analysis		Pre-Program Matching Period	Installation Period	Study Period	Future Participants	

- The proposed study design uses a quasi-experimental approach, matching on future participants to minimize selection bias.
- The study will address electric cooling savings and electric & gas heating savings for gas system types. Electric heating for electric system types will not be addressed in this study due to the anticipated low levels of program participation.
- Guidehouse performed a statistical power analysis to confirm viability of a whole home consumption data analysis.

Statistical Power Analysis

	May - Sep 21	Oct 21 – Apr 22	May – Sep 22	Oct 22 – Apr 23	May – Sep 23	Oct 23 – Apr 24
Cooling Season Analysis	Pre-Program Period	Installation Period	Study Period	Future Participants		
Required		2,500+		3,750+		
Actual		2,116		TBD (projecting 5,000)		

	May - Sep 21	Oct 21 – Apr 22	May – Sep 22	Oct 22 – Apr 23	May – Sep 23	Oct 23 – Apr 24
Heating Season Analysis		Pre-Program Period	Installation Period	Study Period	Future Participants	
Required			Electric: 1,000+ Gas: 25+		Electric: 1,500+ Gas: 300+	
Actual			Electric: 1,085 Gas: 1,294		TBD (projecting 2,700 electric & 3,400 gas)	

Note: Actual customer counts assume 75% of customers will be dropped due to cross-participation and data cleaning.

- The results of the power analysis suggest the whole-home consumption analysis **is likely viable**.
- Working with stakeholders, we will determine key checkpoints along the way that indicate whether we are likely to achieve statistically significant results. We will document in advance of the study how to proceed under each scenario.

Estimate Energy Savings

Data Management	Matching	Regression Analysis
Gather and aggregate all required data, including, for example: AMI (hourly) electric consumption, daily or monthly gas consumption, weather, observable customer and home characteristics (age, income, geographic location, HER participation)	As a pre-processing step in the analysis, compare participants to future participants and potentially match based on energy consumption, income, age and other observable characteristics, as feasible	Estimate a lagged dependent variable regression model to estimate energy impacts, controlling for time-varying factors, such as weather; we will consider post-regression adjustments, as needed

Guidehouse will gather input and feedback from stakeholders on the proposed study method and at key milestones throughout the analysis.

Surveys

Challenge

Several recent studies (Apex Analytics 2021, DNV-GL 2022, DNV-GL 2021) found smart thermostat program participants were more likely to make changes that significantly affected energy consumption concurrent with the purchase of smart thermostats.

Mitigation Strategy

We will conduct surveys with participants and future participants to assess whether incidence of "major changes" (e.g., occupancy change, new HVAC, remodel/addition, PV install, EV purchase) differs. We propose surveying participants and future participants in 2024 Q1 - Q2, targeting 2,000+ completes.

Outcome

If surveys suggest differences in the incidence of major changes during the study period between study participants and future participants, we will consider post-regression adjustments to the savings estimate.

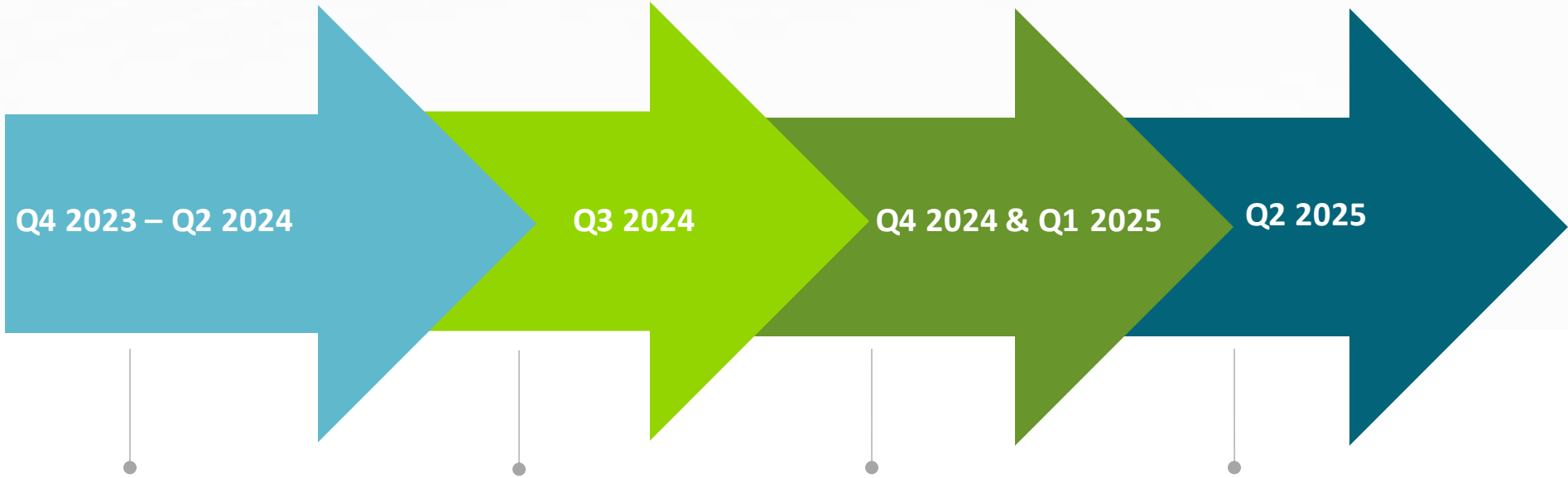
Guidehouse
Outwit Complexity

Modified Measure Submission

- Based on the study findings, we will develop and submit a modified measure workpaper to the Technical Subcommittee for inclusion in the 2026 MEMD
- What results will the study produce?
  - Verified gross savings. Installation rate is implicit to the study design, but a net-to-gross ratio would need to be applied to determine verified net savings.
  - The study will not estimate impacts for multi-family or for electric heating systems. We will propose using the same percent savings values for these building and system types.
  - The baseline is a market blend of thermostat types given we will not be able to identify the type of thermostat being replaced.

Schedule

Proposed timeline for the calibration study:



- Stakeholder Engagement on Study Design
- Data collection
- Field Surveys

- Matching
- Stakeholder Engagement on Match Quality & Survey Findings

- Analysis
- Stakeholder Engagement on Results

- Present during April EWR Collaborative
- Submit modified measure by May 1

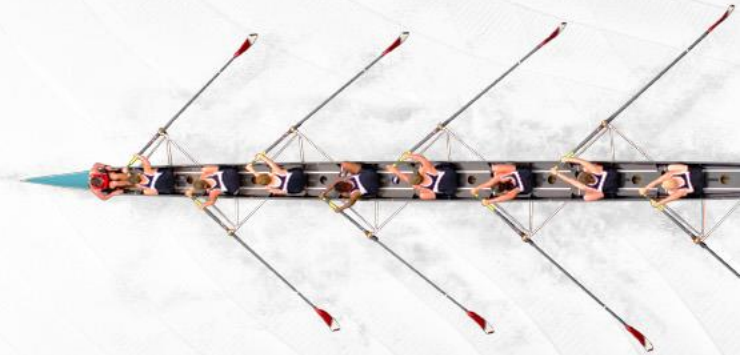
Guidehouse
Outwit Complexity

Your Guides

Bethany Glinsmann
Associate Director
Bethany.Glinsmann@guidehouse.com

Sahil Popli
Associate Director
Sahil.Popli@guidehouse.com

Debbie Brannan
Director
Debbie.Brannan@guidehouse.com



Guidehouse
Outwit *Complexity*

Guidehouse
Outwit *Complexity*

Appendix: Power Analysis

Power Analysis to Confirm Viability

What is a power analysis?

A calculation to assess the ability to identify statistically significant impacts given the expected magnitude of the impact, variation in the data, and accepted level of uncertainty (e.g., 90% confidence level)

Power analysis purpose:

Confirm there is a sufficiently large program population to proceed with the study:

- Electric cooling savings
- Gas heating savings
- Electric heating savings (for gas system types)

Electric heating for electric system types will not be addressed in this study due to the anticipated low levels of program participation.

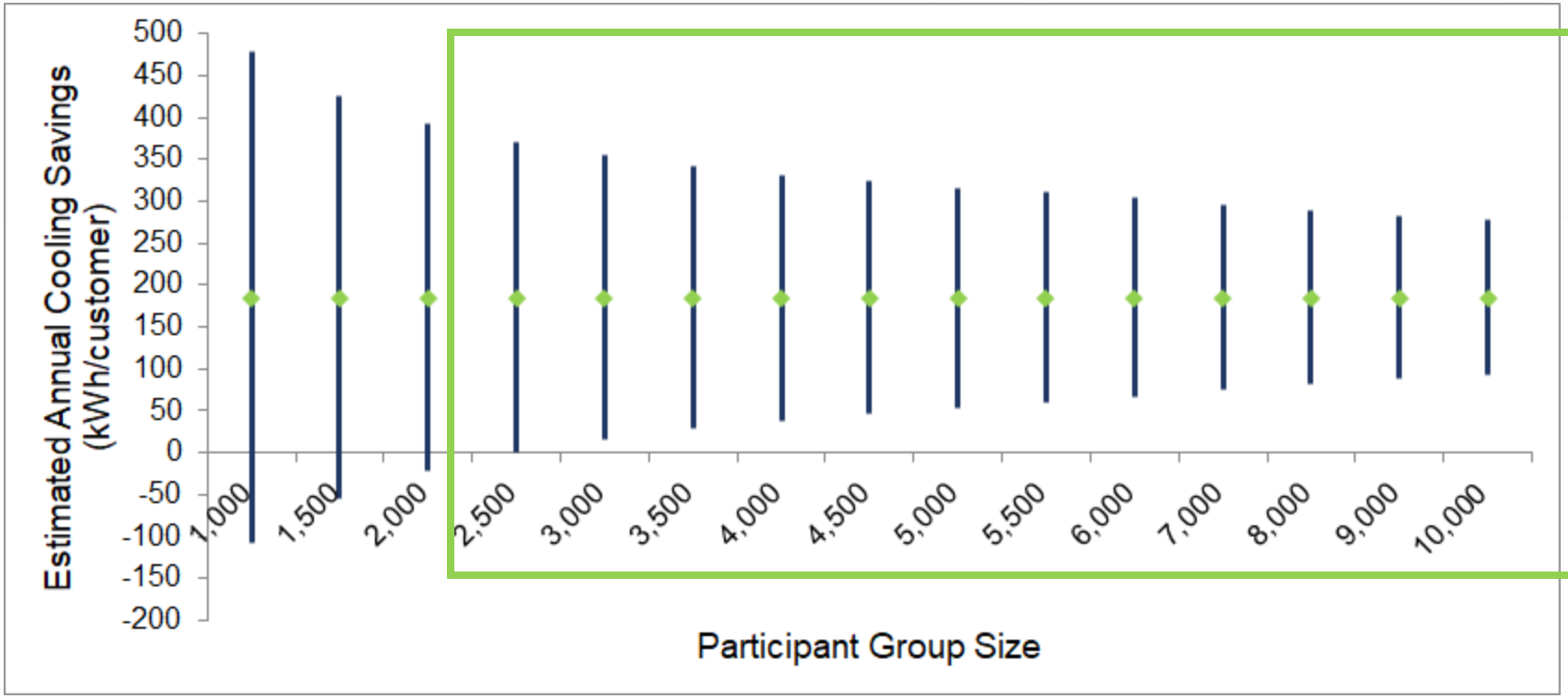
Power Analysis Assumptions

Power analysis input assumptions:

1. Expected magnitude of impact
   - Updated using the results from the recently completed meta-analysis. We applied MEMD weights across weather zone, system type, and vintage.
     - Electric cooling savings: 187 kWh (9.31% of cooling load)
     - Gas heating savings: 93 therms (7.95% of heating load)
     - Electric heating savings for gas systems: 10 kWh (2.08% of heating load)
2. Variation in the data
   - Based on ComEd and EmPOWER evaluations using AMI data
3. Accepted level of uncertainty.
   - Guidehouse assumes a 90% confidence interval

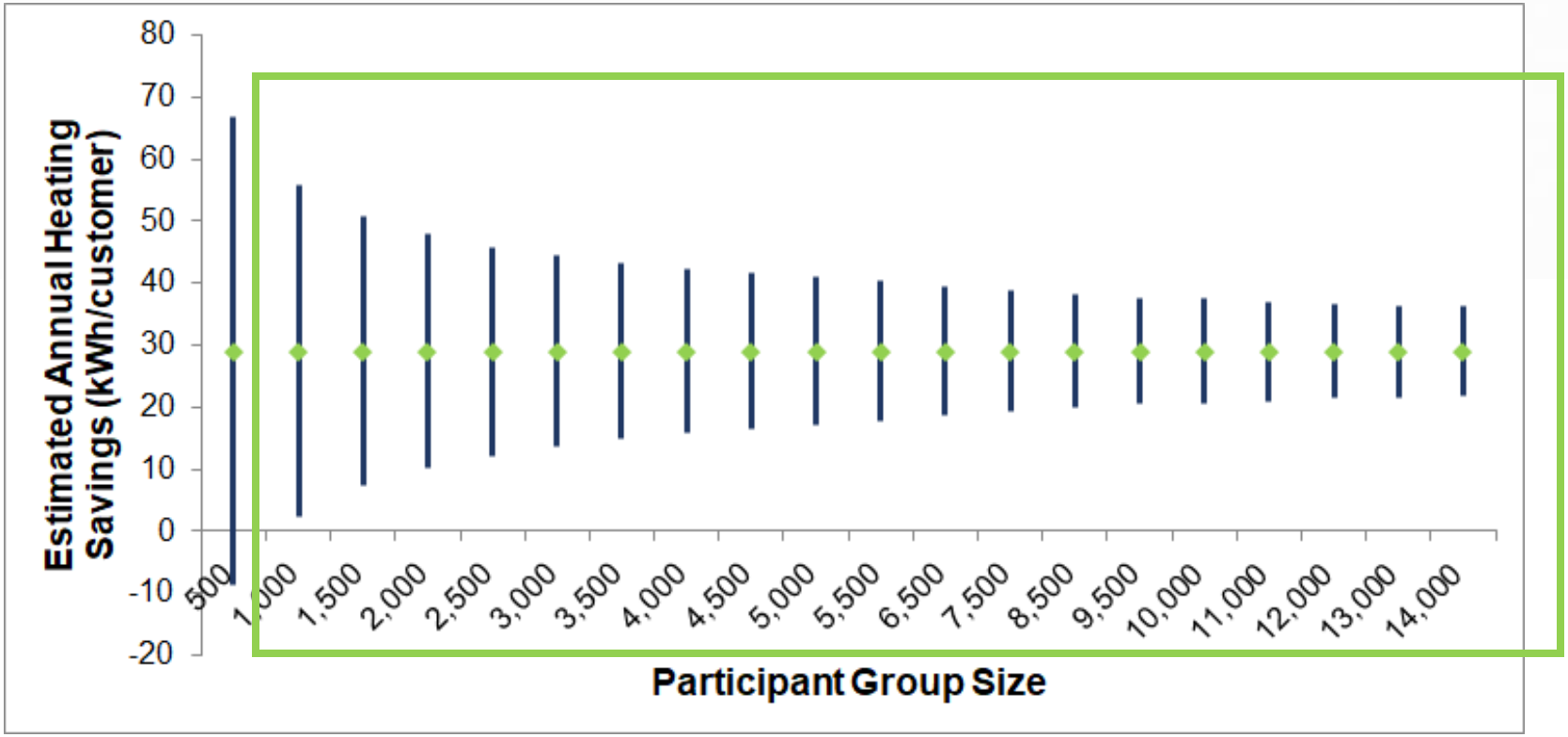
Electric Cooling Power Analysis

- Impacts are statistically significant if the 90% confidence interval (vertical black bars) does not include zero.
  - A result can be statistically significant and have nearly 100% relative precision (e.g., 60 kWh +/- 60)
- To reliably detect smart thermostat impacts on electric cooling, the study population must include **at least 2,500 participants**.



Electric Heating (Gas Systems) Power Analysis

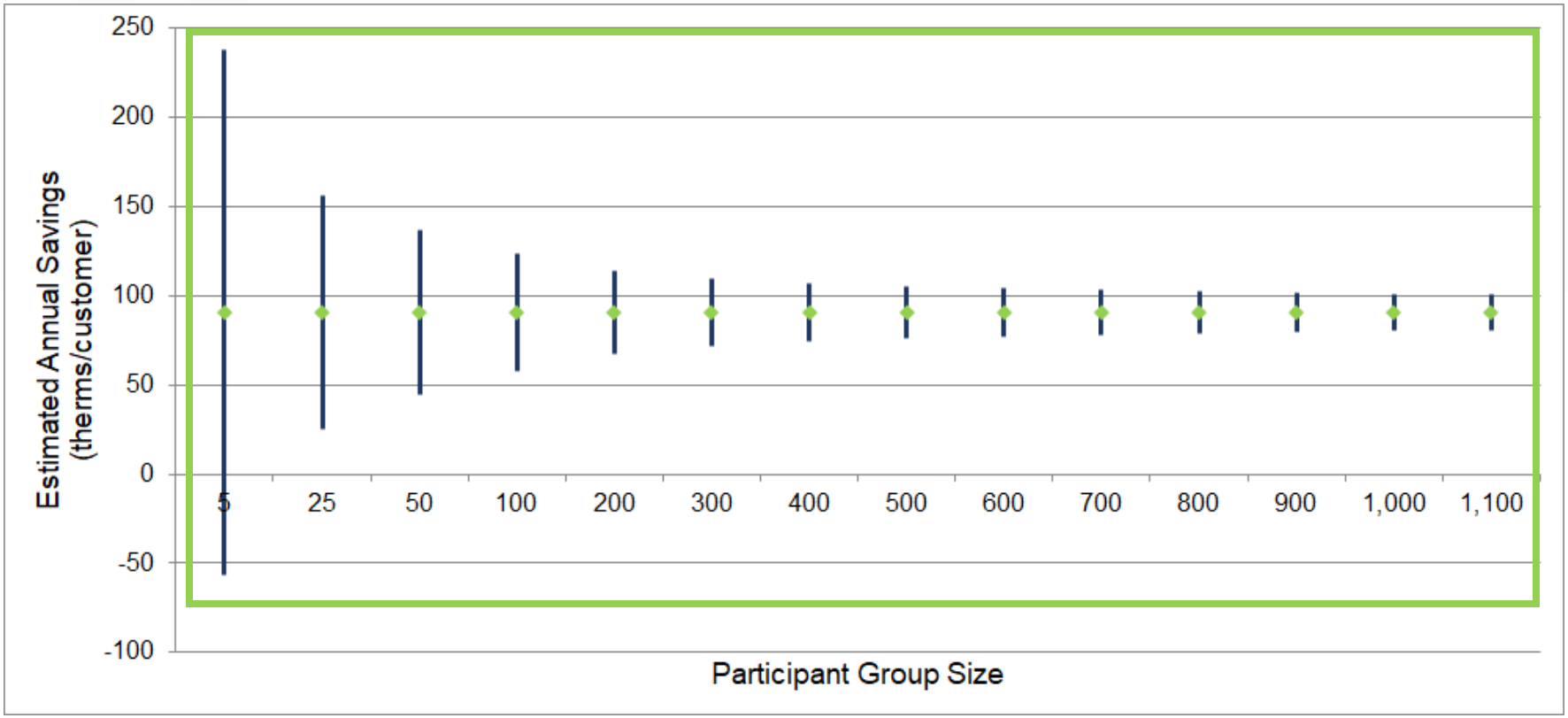
To reliably detect smart thermostat impacts on electric heating, the study population must include **at least 1,000 participants** with gas heating systems.



Guidehouse
Outwit Complexity

Gas Heating Power Analysis

To reliably detect smart thermostat impacts on gas heating, the study population must include **at least 25 participants** with gas heating system types.



Guidehouse
Outwit Complexity

Guidehouse
Outwit *Complexity*

Appendix:
Study Methods Reviewed

Study Methods Reviewed

Meta-Analysis

Description

- Compile results from recent smart thermostat studies in other jurisdictions
- Develop method for synthesizing results to account for Michigan characteristics

Status

Study completed and accepted as a modified measure in the 2024 and 2025 MEMD

Whole-home Consumption Analysis

Description

- Regression analysis of AMI data using a matched comparison group consisting of future installers.
- Conduct customer surveys to collect information about other major changes impacting energy use; incorporate adjustments to the analysis, as necessary.

Status

UMP recommended approach; revisited power analysis using results of meta-analysis

2026 MEMD

Metering Study

Description

- Recruit recent t-stat purchasers to participate in a metering study
- Pay participants to delay installation of smart thermostat to enable metering of both pre- and post-installation periods

Status

Limitations associated with selection bias, external validity as well as cost and study duration considerations

2027 MEMD

Building Simulation

Description

- Use DOE2 models currently used to develop savings for MEMD measures
- Baseline behavior determined by Housing Baseline and Furnace Metering studies
- Incorporate telemetry data from thermostat manufacturers and/or primary data collection to inform post-smart thermostat setpoint behavior

Status

Determined to not be a valid option due to limited granularity of DOE2 inputs

ENERGY STAR

Description

- Use the ENERGY STAR Connected Thermostat method that relates HVAC runtime to the difference in outdoor and indoor temperature
- Measures performance relative to a common baseline which maintains a constant indoor air temperature

Status

UMP recommends method should not be used as the primary evaluation method